

JAPAN

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JIS Z 9121 (1997) (English): Lighting for outdoor track and field, outdoor soccer fields and rugby fields

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*The citizens of a nation must
honor the laws of the land.*

Fukuzawa Yukichi

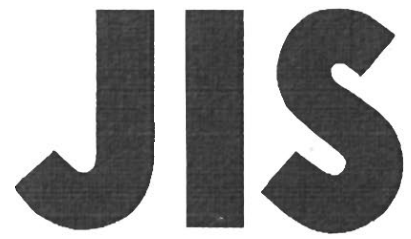
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JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS Z 9121 : 1997

Lighting for outdoor tracks and
fields, outdoor soccer fields and
rugby fields

ICS 91.160.20; 97.220.10

Descriptors : sports facilities, outdoor electric equipment, artificial lighting,
lighting levels, specifications

Reference number : JIS Z 9121 : 1997 (E)

Z 9121 : 1997

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

Date of Establishment: 1989-01-01

Date of Revision: 1997-03-20

Date of Public Notice in Official Gazette: 1997-03-21

Investigated by: Japanese Industrial Standards Committee

Divisional Council on Electricity

JIS Z 9121:1997, First English edition published in 1997-08

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107 JAPAN

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Printed in Japan

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Lighting for outdoor tracks and fields, outdoor soccer fields and rugby fields

1 Scope This Japanese Industrial Standard specifies the lighting for outdoor tracks and fields, outdoor soccer fields and rugby fields, and their combined use facilities.

Remarks : The following standards are cited in this Standard:

JIS C 1609 *Illuminance meters*

JIS C 7612 *Illuminance measurements for lighting installations*

JIS Z 8113 *Glossary of lighting terms*

2 Definitions For the purpose of this Standard, the definitions given in **JIS Z 8113** apply.

3 Requirements for execution of lighting

3.1 Investigation items At planning lighting for the facilities, the following matters shall be investigated in advance.

(1) Structure of facilities

- (a) Shape and dimensions of facility and whether stand or fence exists.
- (b) Material, color, reflectance, etc. of field surface.
- (c) Material, color reflectance of stand or fence, etc., if provided.
- (d) Places where luminaires are able to be mounted, or the like.

(2) **Details in utilization** Distinction between the cases of athletic sports use and recreation use, and distinction between cases where sports are televised and where not done so.

(3) **Environments of facilities** Whether there are nearby residence district, road, railway, airfield, etc., and positional relation with them.

(4) **Meteorological conditions** Conditions of snow fall, injury from salt, strong wind, etc.

(5) **Power supply condition** Electrical system, service voltage, frequency, power capacity, etc.

3.2 Design of lighting In designing lighting, attention shall be paid to the following matters:

(1) **Illuminance and its uniformity ratio** Give sufficient lighting to field surface and secure the good uniformity ratio.

(2) **Glare** Take into consideration the decrease of direct glare from the luminaires as far as possible so that a large inference to sports is not caused.

In the facilities where professional sports or official sports are played, it should be taken into account that the uncomfortable glare is reduced.

- (3) **Stroboscopic phenomenon** In the case of burning an electric discharge lamp by commercial frequency (50 Hz or 60 Hz), decrease the stroboscopic phenomenon as far as possible.
- (4) **Light source** Select a suitable light source by taking into consideration the following matters:
 - (a) Luminous efficacy of the lamp (in discharge lamp, this means overall efficacy including the ballast loss)
 - (b) Life and luminous flux maintenance factor
 - (c) Light source color and color rendering properties
- (5) **Others** Take into consideration also the following matters:
 - (a) Selection of materials and method in construction suitable for natural environment
 - (b) Easiness of maintenance and control
 - (c) Economical property
 - (d) Fine view
 - (e) Safety lighting
 - (f) Spare circuits

4 Standard of lighting

4.1 Lighting range The lighting range shall be the whole field surface.

The field surface herein indicates the following range.

- (1) In the case of track and field, the track and the range surrounded by it. However, in the case where sport facilities exist outside the track, it includes the whole sport facilities.
- (2) In the case of soccer field, the range surrounded by touchline and goal line.
- (3) In the case of rugby field, the range surrounded by touchline and dead-ball line.

4.2 Illuminance and its uniformity ratio The average illuminance (horizontal illuminance) of field surface and its uniformity ratio shall be as shown in Table 1.

Measuring method of illuminance shall be as shown in the Annex.

Table 1 Average value and uniformity ratio of horizontal illuminance

Classification	Horizontal illuminance	
	Average value lx	Uniformity ratio ⁽¹⁾
Official sport ⁽²⁾	500 min.	0.50 min.
Unofficial sport ⁽³⁾	200 min.	0.40 min.
Recreation ⁽⁴⁾	100 min.	0.25 min.

Notes (1) Uniformity ratio of horizontal illuminance is calculated by the formula (1).

$$U_h = \frac{Eh_{\min}}{Eh_{\text{ave}}} \dots\dots\dots (1)$$

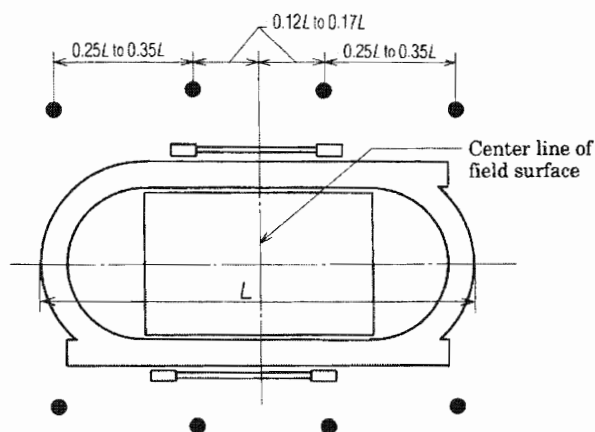
where, U_h : uniformity ratio of horizontal illuminance
 Eh_{\min} : minimum value of horizontal illuminance (lx)
 Eh_{ave} : average value of horizontal illuminance (lx)

- (2) Sports the results of which are remained as officially recognized record
 (3) Sports other than official sports
 (4) Sports for enjoying leisure or for improving health

Remarks : Illuminance and its uniformity ratio for television photographing shall be as given in 5.

4.3 Arrangement of luminaires The arrangement of luminaires shall be as specified in following each item:

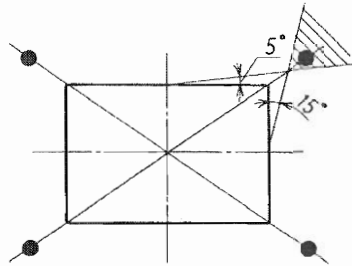
- (1) In the cases of track and field and combined use sport field (track and field sports, soccer, rugby): The arrangement shall be, as a rule, side arrangement (8 places) shown in Fig. 1.



Remarks : ● mark is the set position of luminaires.

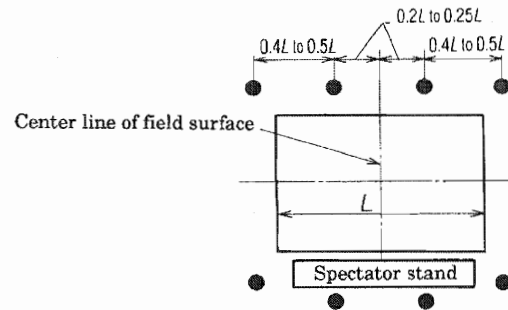
Fig. 1 Side arrangement (8 places)

- (2) In the case of exclusive soccer field: The arrangement shall be, as a rule, corner arrangement (4 places) shown in Fig. 2 or side arrangement (8 places) shown in Fig. 3.



- Remarks 1 ● mark is the set position of luminaires.
2 Luminaires shall be arranged in oblique line section.

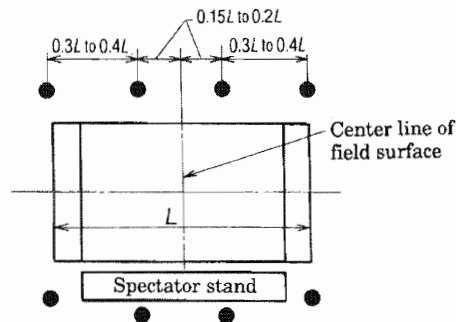
Fig. 2 Corner arrangement (4 places)



- Remarks : ● mark is the set position of luminaires.

Fig. 3 Side arrangement (8 places)

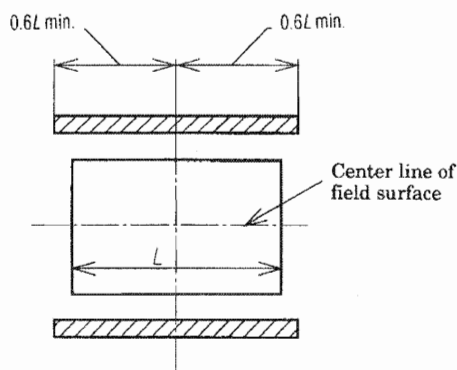
- (3) In the case of exclusive rugby field: The arrangement shall be, as a rule, side arrangement (8 places) shown in Fig. 4.



- Remarks : ● mark is the set position of luminaires.

Fig. 4 Side arrangement (8 places)

- (4) Without regard to the above specifications, if the roof on which the luminaires are able to be mounted cover the spectator stand and the height of the luminaires satisfies the formula (2), the luminaires are allowed to be arranged (side arrangement) on the roof without using lighting poles (see Fig. 5).




Remarks : Mark  indicates the range of setting luminaires.

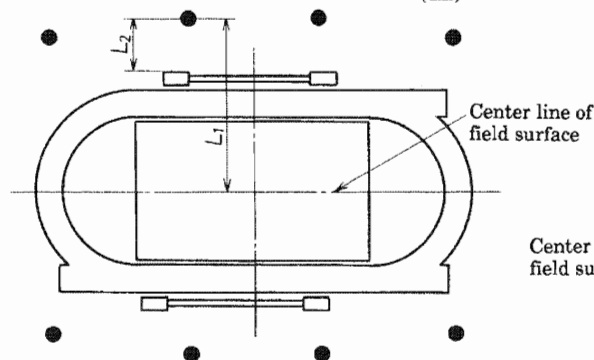
Fig. 5 Example of arrangement of luminaires
(for soccer field)

4.4 Attaching height of luminaires The attaching height of luminaires shall, as a rule, be determined by using formula (2) and Fig. 6, Fig. 7 and Fig. 8 in the case of side arrangement, and by using formula (3) and Fig. 9 and Fig. 10 in the case of corner arrangement.

(1) In the case of side arrangement

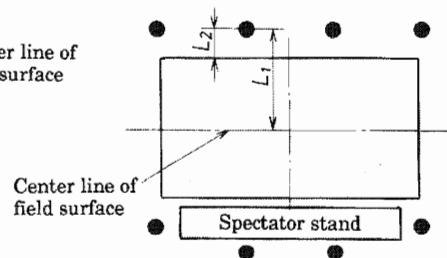
$$\left. \begin{array}{l} 0.35L_1 \leq H \leq 0.6L_1 \\ \text{and} \\ L_2 \leq H \leq 4L_2 \end{array} \right\} \dots\dots\dots (2)$$

where, L_1 : horizontal distance from the center line of field surface to the luminaire at the lowest stage (m)
 L_2 : horizontal distance from the corner of field surface to the luminaire at the lowest stage (m)
 H : attaching height of luminaire at the lowest stage (m)



Remarks : ● mark is the set position of luminaires.

Fig. 6 Plan (for track and field)



Remarks : ● mark is the set position of luminaires.

Fig. 7 Plan (for soccer and rugby fields)

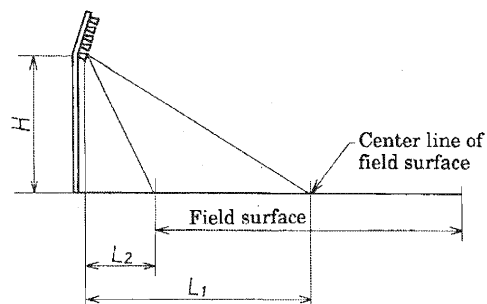
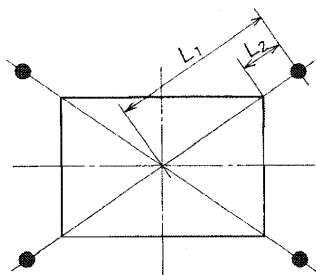


Fig. 8 Transverse view

(2) In the case of corner arrangement

$$\left. \begin{array}{l} 0.35L_1 \leq H \leq 0.6L_1 \\ \text{and} \\ H \leq 3L_2 \end{array} \right\} \dots\dots\dots (3)$$

where, L_1 : horizontal distance from the center of field surface to the luminaire at the lowest stage (m)
 L_2 : horizontal distance from the corner of field surface to the luminaire at the lowest stage (m)
 H : attaching height of luminaire at the lowest stage (m)



Remarks: ● mark is the set position of luminaires.

Fig. 9 Plan

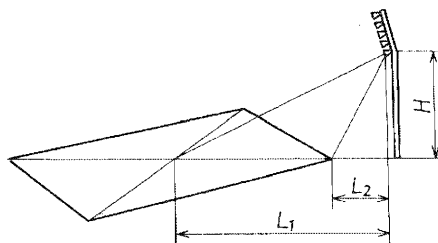


Fig. 10 Transverse view

4.5 Luminaire Luminaire shall be floodlight and, selected according to Table 2, as a rule.

Table 2 Selection of luminaire

Classification	Arrangement of luminaires	Classification of distribution of luminous intensity of floodlight		
		Narrow angle type ⁽⁷⁾	Medium angle type ⁽⁸⁾	Wide angle type ⁽⁹⁾
Official sports ⁽²⁾ and unofficial sports ⁽³⁾	Corner arrangement ⁽⁵⁾	⊙	○	○
	Side arrangement ⁽⁶⁾	○	⊙	○
Recreation ⁽⁴⁾	Corner arrangement or side arrangement	○	○	⊙

Notes (5) The method to arrange luminaire in the neighbourhood of four corners of field surface.

(6) The method to arrange luminaire along the longitudinal direction of field surface.

(7) That of beam divergence angle (up to $\frac{1}{10}$ of the maximum luminous intensity) less than 30°.

(8) That of beam divergence angle of 30° or more to 60° excluding.

(9) That of beam divergence angle of 60° or more.

Remarks : ⊙: to be used mainly ○: to be used where necessary

5 Standard of lighting for television photographing

5.1 Illuminance and its uniformity ratio Illuminance and its uniformity ratio shall have the relevant values shown in Table 3.

Measuring method of illuminance shall be as shown in the Annex.

Table 3 Average value and uniformity ratio of illuminance

Classification of illuminance	Average value lx	Uniformity ratio ⁽¹⁰⁾
Vertical illuminance ⁽¹¹⁾	1 000 min.	0.30 min.
Horizontal illuminance ⁽¹²⁾		0.50 min.

Notes (10) Uniformity ratio is calculated by formula (4) and formula (5).

$$\text{Uniformity ratio of vertical illuminance } U_v = \frac{E_{v_{\min}}}{E_{v_{\max}}} \dots\dots\dots (4)$$

where, U_v : uniformity ratio of vertical illuminance

$E_{v_{\min}}$: minimum value of vertical illuminance (lx)

$E_{v_{\max}}$: maximum value of vertical illuminance (lx)

$$\text{Uniformity ratio of horizontal illuminance } U_h = \frac{E_{h_{\min}}}{E_{h_{\max}}} \dots\dots\dots (5)$$

where, U_h : uniformity ratio of horizontal illuminance

$E_{h_{\min}}$: minimum value of horizontal illuminance (lx)

$E_{h_{\max}}$: maximum value of horizontal illuminance (lx)

(¹¹) Vertical illuminance of the side where camera is located and at the position 1.5 m high from the ground.

(¹²) Horizontal illuminance on the field surface.

Informative reference : Lighting of spectator stand: The vertical illuminance of the part adjacent to the field surface within the spectator stand facing to the side where camera is set should be kept at a level approximately 0.25 times the values specified in Table 3.

5.2 Decreasing of flicker In the case of using discharge lamps, such counter-measures that they are connected with three-phase power source in order to decrease the flicker appearing on the television technical drawing shall be taken.

5.3 Light source color and color rendering properties Light source color and color rendering properties shall have the relevant values given in Table 4.

Table 4 Light source color and color rendering properties

Light source color	Within a range of color temperature 6 000 K to 3 000 K
Color rendering properties	General color rendering index of 55 or more

6 Maintenance and control For maintenance and control of lighting installation, the following procedures shall be performed periodically:

- (1) Check on burning condition
- (2) Exchange of lamp
- (3) Exchange of ballast (limited to separate type)
- (4) Cleaning
- (5) Check on luminaire
- (6) Check and repairing of lighting pole
- (7) Check and repairing of wiring and switching device
- (8) Measurement (comply with Annex) and record of illuminance

Annex Measurement methods of illuminance

1 Scope This Annex specifies the measurement methods of horizontal illuminance and vertical illuminance of outdoor tracks and fields, outdoor soccer fields and rugby fields.

The general rules of illuminance measurement other than those specified in this Annex shall be in accordance with **JIS C 7612**.

The illuminance meter to be used shall be the general class AA specified in **JIS C 1609** or those equivalent or superior thereto in performance.

2 Measurement method of illuminance

2.1 Measuring range The measuring range of illuminance shall be the whole field surface.

2.2 Measuring points The measuring points of illuminance shall be intersecting points of the lines dividing the field at basic intervals of 10 m.

- (1) In the track and field where the intersecting points are out of the field surface and distant less than 5 m from the field surface boundary as shown in Annex Fig. 1, the illuminance at those points is not necessarily measured.
- (2) In the soccer field, 96 points shown in Annex Fig. 2 shall be taken as reference.
- (3) In the rugby field, 128 points shown in Annex Fig. 3 shall be taken as reference.

If the dimension of the field differs from Annex Figs. 1 to 3, the measuring points shall be increased or decreased according to its dimension.

2.3 Measurement of horizontal illuminance Measure the horizontal illuminance on the points above the ground surface by not more than 15 cm at measuring points shown in 2.2.

2.4 Average value of horizontal illuminance The average value of horizontal illuminance shall be calculated by the formula (1) or (2).

(1) Track and field

$$Eh_{ave} = \frac{1}{n} \sum_{i=1}^n E_i \dots\dots\dots (1)$$

where, Eh_{ave} : average value of horizontal illuminance
 E : horizontal illuminance at measuring point
 n : number of measuring points

(2) Soccer field and rugby field

$$Eh_{ave} = \frac{1}{4N} \left(\sum_{i=1}^4 E_{\square i} + 2 \sum_{i=1}^o E_{\triangle i} + 4 \sum_{i=1}^p E_{\circ i} \right) \dots\dots\dots (2)$$

where, Eh_{ave} : average value of horizontal illuminance

E_{\square} : horizontal illuminance at corner point

E_{\triangle} : horizontal illuminance at side point

E_{\circ} : horizontal illuminance at inner point

o : number of side points

p : number of inner points

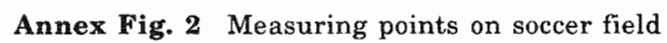
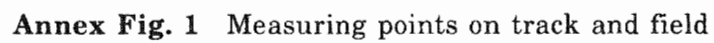
N : number of blocks surrounded by dividing lines

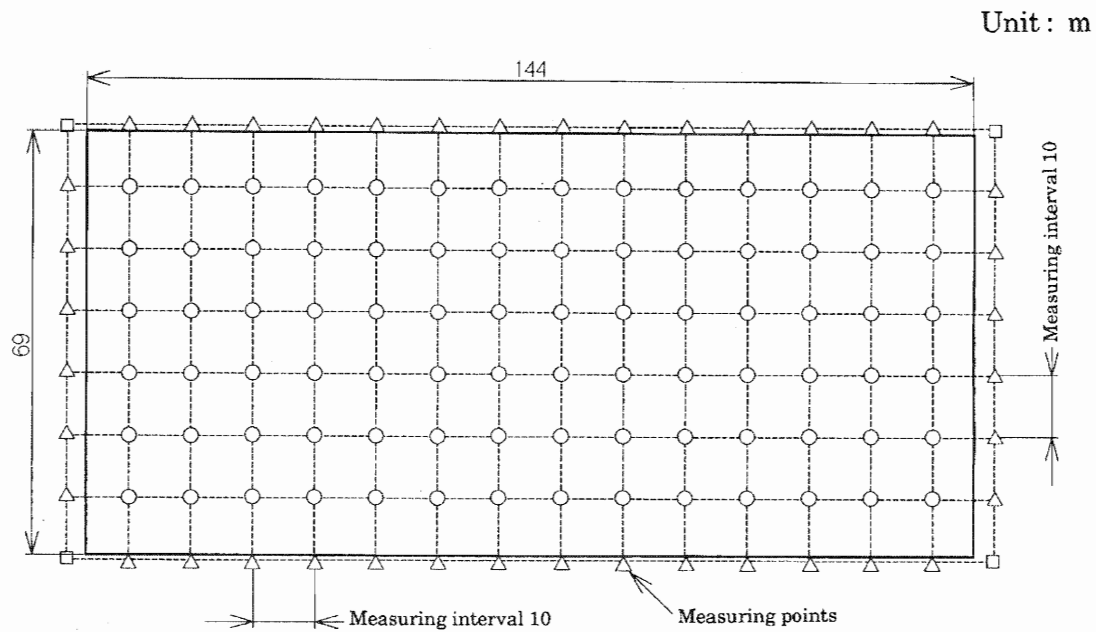
2.5 Measurement of vertical illuminance In the sport field where television picture is taken, measure the vertical illuminance of 1.5 m above the ground surface at positions shown in 2.2. The measuring directions of vertical illuminance shall be four directions shown in Annex Fig. 4, taking, however, the direction toward the main camera as the object to be evaluated.

The average value of vertical illuminance shall be the value obtained by simply averaging the measured values in each direction.

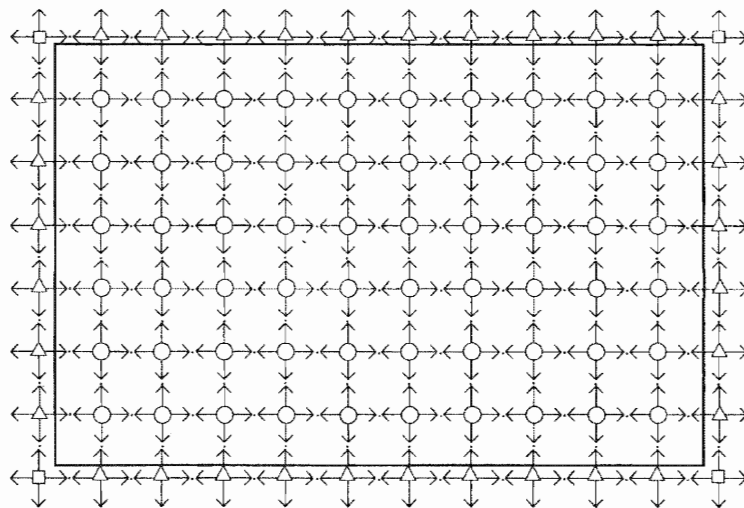
2.6 Omission of measuring points

- (1) In the case where both the lighting facilities and measuring range are symmetrical to the center line, perform the measurement on either one symmetrical surface and the other part may be omitted.
- (2) In the case of taking the data as the target of maintenance and control, the tendency of whole illuminance may be judged, by measuring the illuminance at several points nearby the center.





Annex Fig. 3 Measuring points on rugby field



Remarks : Arrow marks indicate the direction of light receiving surface of illuminance meter.

Annex Fig. 4 Measuring directions of vertical illuminance (for soccer field)

Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

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